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Evaluating the Interspersal Procedure Using Free Access to a Competing Reinforcer

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EVALUATING THE INTERSPERSAL PROCEDURE USING FREE ACCESS TO A COMPETING REINFORCER

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Abstract

Previous research has shown that interspersing additional easy problems among difficult target problems increases target problem fluency and student preference for an assignment. Nonetheless, there have been some contradictory findings concerning the efficacy of the interspersal procedure, so more research is needed to determine whether teachers should use this procedure for academic assignments. The current study attempted to replicate and extend the research on this procedure by using access to a competing reinforcer (an iPad) and a homework analogue. Fourth-grade students were given access to an iPad, but were told to work first for 10 minutes each on a control and experimental (interspersal) assignment. All students worked for the entire time and did not engage with the iPad until given explicit permission. Students completed more total problems and answered more total problems and digits correctly on the experimental assignment but completed more target problems on the control assignment. Students liked the experimental assignment more and rated it as less difficult. When controlling for students' ability to delay academic gratification, they also rated the experimental assignment as less time-intensive. Although the current preference results are in line with previous research, the differences in preference scores were small and not practically significant. Furthermore, the fact that students completed more target problems on the control worksheet is a serious concern given that the purpose of using the interspersal procedure is to increase reinforcement without sacrificing learning. Thus, overall, the results of the current study do not support the use of the interespersal procedure in instructional assignments.

Introduction

According to Haring and Eaton's (1978) hierarchy of skill development, there are four stages of learning: acquisition, proficiency, generalization, and adaptation. Once a student learns a new skill (acquisition), teachers then focus on promoting fast and accurate responding (proficiency), as well as application to new situations (generalization). Research has shown that skill proficiency and generalization can be enhanced through student engagement in high rates of active, accurate academic (AAA) responding (Skinner, Belfiore, Mace, Wiliams-Wilson, & Johns, 1997; Skinner, Pappas, & Davis, 2005). Two common methods that teachers use to promote AAA responding are independent seatwork (ISW) and homework. Homework is an especially important educational tool because it provides students with additional opportunities to review material covered in class and has been correlated with higher grades and improved standardized testing performance (Trautwein, 2007).

Nevertheless, when given opportunities for practice, children do not always engage in AAA responding, either because they *can't* or they *won't*. Occasionally, children are unable to complete AAA responding due to circumstances such as confusion about the assignment, skill deficiencies, lack of materials, or insufficient time (Skinner, 2004); these are referred to as *can't do* problems. An alternative situation is when children have the ability to complete AAA responding, but choose not to engage in the task, which is known as a *won't do* problem (Skinner, 2004). Because academic engagement in the latter case is a matter of choice, educators can use empirically validated strategies to increase the probability of student engagement (Skinner et al., 2005).

One method that educators can use to promote academic engagement is to decrease the task effort. Research shows that when given the choice between two behaviors when reinforcement is held constant, students will engage in whichever behavior requires less effort (Billington & DiTommaso, 2003). For instance, when faced with the choice between completing a 4-page assignment and a 2-page assignment, students would be more likely to choose the latter since it requires less effort. Therefore one way to increase the probability that students will choose to engage in an assignment is to decrease the response effort required (Skinner et al., 2005). One method educators can use to reduce response effort is decreasing the number of assignment tasks (Logan & Skinner, 1998). For example, educators can reduce the number of math problems that must be completed in an assignment. Educators can also decrease response effort by reducing the task difficulty (Meadows & Skinner, 2005). This can be accomplished by removing difficult questions and replacing them with easier, shorter questions. Nevertheless, while decreasing response effort does improve student perception of the assignment and increase the probability of academic engagement, it can also impair academic achievement (Dunlap & Kern, 1996). Decreasing task effort can reduce skill development and academic achievement by reducing the number of opportunities to learn new material (Cates et al., 2003). Cooke, Guzaukas, Pressley, and Kerr (1993), for instance, evaluated the relationships between task difficulty, student preference, and academic performance by using assignments that had 100% new material (difficult) or 30% new material (easy). The researchers found that although students preferred the easy assignments, reading and spelling rates were higher for the difficult assignments.

An alternative method that educators can use to increase student preference for assignments is to alter the rate of reinforcement. According to Herrnstein's (1961) matching law, people's relative rates of responding for different behaviors will match their relative rates of reinforcement based on a variable interval reinforcement schedule. Thus, whether students engage in an assignment or some other, non-task-related behavior will depend on the rate of reinforcement for each choice (Skinner, 2002). Teachers can therefore increase the probability of academic engagement by increasing the rate of reinforcement for the assignment (Skinner, Robinson, et al., 1996). Mace, McCurdy, and Quigley (1990) used a single-case design to evaluate the effect of changing reinforcement schedules on time spent on division and multiplication tasks for two children in special education. When the reinforcement schedule was the same for the two tasks, the students spent approximately the same amount of time on both, but when the schedule changed to a 2:1 ratio across assignment types, the students spent twice as long on the assignment with the denser schedule of reinforcement (Mace et al., 1990). While increasing reinforcement schedules has been shown to be effective in promoting academic engagement, it also has its limitations. This intervention is not practical when applied to actual ISW or homework situations, as teachers are unable to simultaneously monitor and respond to an entire class' set of academic behaviors (in the case of ISW) or are not present to do so (in the case of homework; Skinner, Robinson, et al., 1996).

In 1996, Skinner, Robinson, et al. first introduced what would become known as the discrete task completion hypothesis. Students often have an abundant learning history of receiving both positive and negative reinforcement for completing academic assignments (Skinner, Robinson, et al, 1996). Both in the classroom and at home, students receive positive reinforcers such as teacher / parent praise or access to a preferred activity contingent upon ISW / homework completion. In addition, task completion is also negatively reinforced by allowing students to escape from further task engagement or teacher / parent disapproval concerning an uncompleted task. Because assignment completion is so frequently reinforced, Skinner et al. (1999) posited that it becomes a reinforcing stimulus through the process of classical conditioning. In addition, according to Pavlov's (1927) process of higher-order conditioning, any event that regularly precedes a reinforcing stimulus can become a conditioned reinforcer. Therefore when assignments are made up of discrete, individual problems, each problem becomes a conditioned reinforcer since its completion precedes the completion of the overall assignment (Skinner, 2002).

The discrete task hypothesis in turn produced a new method of increasing assignment preference: the interspersal procedure. Skinner, Robinson, et al. (1996) posited that if task completion is reinforcing, then interspersing additional easy tasks among difficult tasks should increase the rate of reinforcement by increasing problem completion rates. The benefit of the interspersal procedure is that it enhances positive academic behavior without sacrificing learning (Skinner et al., 1996). Rather than remove difficult problems, as was the case in previous educational research (e.g., Cook et al., 1993), educators can retain the preselected amount of difficult problems and add in additional easier problems instead.

In Skinner, Robinson, et al.'s (1996) pioneer study on the interspersal procedure, college students were given 305 seconds to work on each of two math assignments: a control worksheet with 16 three-digit by two-digit (3X2) multiplication problems and an experimental worksheet with 16 corresponding 3X2 problems and six interspersed 1X1 problems. There was no difference in accuracy or number of 3X2 problems completed, however students completed significantly more total problems (target and interspersed problems) on the experimental assignment in the given amount of time. When asked to rate the two assignments, students indicated that the experimental assignment was less time-consuming and difficult and required less effort compared to the control assignment. In addition, significantly more students chose the experimental assignment when asked which assignment they would prefer to complete again. In a follow up study, Skinner et al. (1996) gave college students two types of experimental worksheets in addition to the 16 3X2 multiplication problems: one had six 4-digit-plus-4-digit (4+4) problems interspersed whereas the other had six 2-digit-divided by-1-digit (2/1) problems interspersed. The researchers found that although students ranked both interspersal worksheets as equally easy, students rated the 2/1 assignment as less time-consuming and significantly more preferred that assignment compared to the 4+4 interspersal and control assignments. These results suggest that task length, rather than task difficulty, is responsible for student preference for interspersal assignments (Skinner et al., 1996).

Subsequently, researchers began studying whether the interspersal procedure could also be used with younger populations to influence assignment preference. Logan and Skinner (1998) gave sixth-grade students a control assignment with 25 4X1 problems and an experimental assignment with 25 4X1 problems and nine interspersed 1+1 problems. In the eight minutes that they worked on each assignment, students completed equal amounts of 4X1 problems across the two assignments but completed significantly more total problems on the experimental assignment. In addition, significantly more students chose the experimental assignment when asked which assignment they would prefer to work on for homework. These findings demonstrate that the interspersal procedure can also be an effective strategy for promoting academic engagement in younger students as well.

Cates and Erkfritz (2007) replicated and extended interspersal research with school-age children by examining the effect of varying interspersal ratios. Sixth-, seventh-, and eighth-grade students were given four academic packets that contained a control assignment and an experimental assignment with four fixed interspersal rates: no interspersing (FR0, which served as another control), every other problem (FR1), every third problem (FR3), and every fifth problem (FR5). The students worked on each assignment for four minutes. The researchers found that students completed significantly more total problems on the interspersal assignments and preferred them to the control assignments. Furthermore, the researchers found that more students preferred the experimental worksheet as the interspersal ratio became denser (i.e. interspersed more frequently). It is interesting to note that there was a strong correlation ($r = .97$) between the ratio of problems completed on the experimental versus control worksheet and the proportion of students who chose the experimental worksheet. This means that as students completed more problems on the interspersal assignment relative to the control assignment, preference for the interspersal assignment increased. This strong correlation is important because it supports the discrete task completion hypothesis, which posits that as children complete more additional problems in the same amount of time, they receive higher rates of reinforcement and thus are more likely to prefer the interspersal assignment. In addition, the results of this study are noteworthy because 94% of the variance in student preference can be explained by the relative amounts of problem completion on the two assignments, which strongly supports the discrete task completion hypothesis.

Whereas early interspersal studies involved assignments that were equivalent in difficulty, subsequent research has found that the interspersal procedure can also be used to influence students to choose more difficult assignments. Billington and Skinner (2002) gave college students a control worksheet that contained 15 3X2 problems and an experimental worksheet that contained 18 3X2 problems, using the standard FR3 interspersal ratio. The researchers found that even though the experimental worksheet had more target problems, students significantly preferred the experimental worksheet and rated it as less difficult and effortful. Billington, Skinner, Hutchins et al. (2004) gave college students two assignment packets: Packet A had a high-effort worksheet with 18 3X2 problems with all numerals greater than or equal to 4 and a moderate-effort worksheet that had 9 regular 3X2 problems and 9 interspersed (i.e., FR1) 3X2 problems with numerals less than or equal to 4 and Packet B had similar worksheets except that the high-effort worksheet had 6 1X1 problems interspersed after every third problem. With packet A, students predominantly preferred the moderate-effort task, but with packet B, the number of students who chose the high-effort task and rated it as less difficult, time-consuming, and effortful increased significantly. Billington, Skinner, and Cruchon (2004) replicated this experiment with sixth grade students and also found that significantly more students chose to do the high-effort assignment when easy problems were interspersed and rated it as less difficult, time-consuming, and effortful. Collectively, these three studies are encouraging because they demonstrate the possibility of using the interspersal method to increase the likelihood that students will work on difficult assignments.

Despite previous support for the interspersal procedure, some researchers have found contradictory results for the procedure. Robinson and Skinner (2002) gave seventh-grade students experimental and control versions of the Mental Computation and Multiplication subtests from the *KeyMath-Revised* (KM-R; Connolly, 1988). Across the versions of the two subtests, there were no significant differences in difficulty or preference ratings, although the preference rating did approach significance on the Multiplication subtest, where more students choose the experimental version. This counters previous research, which found that students significantly prefer interspersal assignments and rate them as less difficult. One reason for this lack of significant findings could be the addition of the "no difference" option when students were asked which assignment they preferred, since this choice was not included in any prior studies. Robinson and Skinner (2002) also found that the interspersal method improved performance on the Mental Computation subtest but not on the Multiplication subtest. This differs from most interspersal research since there is usually not a difference in academic performance or accuracy. One possible explanation for why performance was enhanced on the mental subtest is Neef, Iwata, and Page's (1977, 1980) hypothesis that the interspersal procedure increases the rate of reinforcement and thus enhances student attention (as cited in Robinson & Skinner, 2002). Hawkins, Skinner, and Oliver (2005) also found that the interspersal method improved problem accuracy differently across cognitive and written math assignments. On the cognitive assignment, the students' accuracy was significantly higher with a 1:3 interspersal ratio compared to 1:1 or no interspersal. On the written assignment, accuracy was significantly higher with the 1:1 ratio compared to the no interspersal condition. The authors point to the difference in attention requirements as a possible explanation for accuracy differences across the interspersal ratios for the two tasks. Perhaps students were unable to sustain their attention across the 1:1 cognitive interspersal task since a 1:1 interspersal ratio requires more total problems compared to a 1:3 ratio. Thus Hawkins et al. (2005) and Robinson and Skinner (2002) demonstrate that the effects of the interspersal method may differ depending on task demands.

The most contradictory evidence against the interspersal procedure comes from the study conducted by McDonald and Ardoin (2007). Although students did significantly prefer the interspersal compared to control worksheets, they completed significantly more target digits correctly on the control worksheets. This contradicts previous research, which has typically found target problem performance to be comparable or greater on the interspersal compared to control worksheet. Nevertheless, this study differed from previous research in several ways, so it is possible that these differences account for the lack of supporting evidence. One notable difference was that McDonald and Ardoin administered control and interspersal worksheets across four sessions to assess the effects of the interspersal procedure over time, so order effects could have biased the results. Furthermore, the researchers used digits correct (one point for each digit answered correctly) in addition to the number of problems correct to evaluate academic performance. When problems correct, instead of digits correct, were used to measure target problem performance in the current study, the results replicated previous research in that students completed equal amounts of challenging problems correctly across both worksheets. This is encouraging since teachers typically count the number of problems correct as opposed to digits correct when grading assignments. Another major deviation was task difficulty: in previous research, easy problems were defined as ones that could be quickly completed by the students. In McDonald and Ardoin's study, however, easy problems were selected based upon pre-assessment data and teacher selection and were not at mastery level for most students. Therefore it is possible that the "easy" interspersal problems were in fact too difficult for some students to complete and thus did not increase the rate of problem completion and reinforcement. Overall, based on the previously mentioned deviations and contrary results, more research is needed to assess the efficacy of the interspersal procedure.

In addition, research is also warranted on other applications of the interspersal procedure beyond ISW assignments. To date, no research has been conducted on whether the interspersal procedure enhances student engagement in homework. While students in previous studies (e.g., Logan & Skinner, 1998) did indicate a preference for completing the interspersal assignment as homework, researchers never attempted to simulate the homework environment to directly test whether students would be more likely to complete it. School and homework environments differ in many ways that can affect student engagement. One important distinction is the amount of behavioral control – in schools, teachers closely regulate assignment completion, but at home, there are varying levels of support and behavioral supervision (Corno, 2000). Thus students might be more likely to become off-task at home given a potential lack of adult monitoring. Another important distinction between home and school is the amount of distractions: students have access to a variety of enjoyable items at home that do not exist at school (e.g. television), and these can interfere with homework completion (Benson, 1988). Particularly given the varying amounts of adult regulation at home, it is important to test whether the interspersal method can improve homework engagement in the presence of competing reinforcing stimuli.

Summary and Experimental Rationale

While homework completion is correlated with several positive outcomes including better standardized-testing performance and higher grades (Trautwein, 2007), approximately 30% of general education students struggle to complete assignments (Polloway, Foley, &

Epstein, 1992). For some students, this problem is a performance deficit: they have the academic skills necessary to do the assignments, but lack motivation to do so. Therefore one area of focus for school psychologists and educators is on ways to increase academic engagement.

According to Skinner's (2002) discrete task completion hypothesis, task completion is a classically-conditioned reinforcer because students have an extensive learning history of being reinforced for completing assignments. Skinner (2002) further posited that each individual problem within an assignment also serves as a conditioned reinforcer since it leads to the completion of the assignment and thus the occurrence of reinforcement. Based on the discrete task completion hypothesis, researchers began studying the interspersal method. If task completion is reinforcing, interspersing easier problems should increase the overall rate of reinforcement. Thus far, all research on the interspersal method has been conducted using classroom independent seatwork (ISW). After sampling an experimental worksheet (interspersal) and control worksheet (non-interspersal), research shows that students are more likely to choose the experimental over the control worksheet, even when the experimental worksheet is more difficult (Billington & Skinner, 2002; Billington, Skinner, & Cruchon, 2004; Billington, Skinner, Hutchins et al., 2004). These results have been used to support Skinner's (2002) discrete task completion hypothesis based on the assumption that students prefer the experimental worksheet since there are more total problems and consequently higher rates of reinforcement.

The purpose of the current study is to extend the research on the discrete task completion hypothesis and interspersal technique. While access to additional reinforcers is limited within the context of ISW, there are a variety of competing reinforcers at home that a student must ignore in order to complete homework assignments. It is therefore important to assess students' motivation to complete experimental and control worksheets in the presence of additional reinforcers to develop a broader understanding of how the interspersal method fares across assignments at school versus home. The results of the experiment will provide more clarity on how reinforcing task completion is. Is it reinforcing enough to compete with preferred reinforcers? Or will student motivation be similarly low across both worksheets when given access to a competing reinforcer?

Method

Participants and Setting

Prior to recruiting participants, the study was approved by the LSU Institutional Review Board (see Appendix A). G*Power 3.1.5 (Faul, Erdelfder, Lang, & Buchner, 2009) was used to calculate the minimum number of participants necessary for the study. Using the criteria of a two-tailed matched *t*-test with $\alpha = .05$, power of .80, and effect size of .50 to .80, 15 to 34 participants were needed. Participants for the study were recruited from a local elementary school. Parental consent was obtained for 19 fourth-grade students, which falls within the necessary sample size range. Students were individually removed from their class for approximately 40 minutes and were brought to an empty classroom to participate in the study. Students were informed that participation was voluntary and were required to give written assent before participating in the study.

Stimulus Materials

Worksheets. During the experiment, students were given two math worksheets in a random, counter-balanced order: an experimental (interspersal) and control (non-interspersal) worksheet. Both worksheets were given on the front of 8.5 X 11 in. white paper sheets with the titles "Assignment A" and "Assignment B". The control worksheet (Assignment A) consisted entirely of age-appropriate, challenging problems. The experimental worksheet (Assignment B) consisted of challenging problems similar to those from the control worksheet, with an additional 1-digit plus 1-digit easy problem interspersed after every 3 challenging problems. This interspersal rate follows the same pattern used by Logan and Skinner (1998) in their interspersal experiment.

The experimenter met with the students' teacher prior to starting the study in order to determine the appropriate type of math problems. Originally, the teacher selected 2-digit by 2-digit multiplication problems as the age-appropriate, challenging problem type, but after the first participant had low accuracy on the target problems (0% correct) and total problem completion rates (6 problems on Assignment A, 4 on Assignment B), the selected problem type was changed to 3-digit minus 3-digit subtraction problems. Control worksheet problems were generated using a math worksheet website (Common Core Sheets, 2014). To equate problem difficulty across the two assignments, the experimental worksheet problems were constructed by altering the digit sequence in the corresponding control problems (Skinner, Robinson, Johns, Logan, & Belfiore, 1996). For instance, since the first problem on the control sheet was 642 - 391, the first problem on the experimental worksheet was 246 - 193. Worksheets were made long enough that students could not finish the packet in the given amount of time (71 problems on Assignment A and 94 on Assignment B). In order to prevent students from counting how many problems they completed on each packet, problems were presented in an uneven amount across rows and columns and were not be numbered or evenly spaced (McDonald & Ardoin, 2007; Skinner, Fletcher, & Wildmon, 1996).

Preference questionnaire. After completing each worksheet, students were given a preference questionnaire to assess student perception of difficulty, effort, time, and preference. In previous studies, researchers typically measured preference by having the students choose which worksheet they thought was more difficult, time-intensive, effortful, and preferable (Skinner et al., 1999). Nevertheless, in order to increase statistical power, student preference in the current study was instead assessed via a Likert-scale, where comparisons were made between the Likert ratings for each scale. Students rated each assignment on the following four questions using a 5-point Likert-scale: 1) How much did you like this assignment? 2) How difficult was this assignment? 3) How much effort would this assignment require to complete from start to finish? 4) How much time would this assignment require to complete from start to finish? (see Appendix B).

Delay of gratification. The Academic Delay of Gratification Scale for Children (ADOG-C; Zhang, Karabenick, Maruno, & Lauermann, 2011; see Appendix C) was used as a measure of the students' ability to delay academic gratification. In 1998, Bembenutty and Karabenick developed the Academic Delay of Gratification Scale (ADOGS) to assess college students' delay of gratification specifically within academic situations. Zhang et al. (2011) then adapted this scale, creating the ADOG-C, in order to measure academic delay of gratification in 5th grade elementary school children. In addition, the ADOG-C was modified to be more applicable for non-Western, Chinese participants. For instance, instead of asking about going on trips or going out to parties, the ADOG-C asked participants about drawing in class or watching their favorite television shows, since these were more appropriate for both the younger age level and non-Western culture. Nevertheless, these activities are also relevant to Western culture so the survey were administered normally to the Western students in the current study. In the original Zhang et al. study, the ADOG-C was found to have high test-rest reliability (r = .87) and a significant correlation between child reports and those of their parents and teachers
(r = .56 and .54, respectively; Zhang et al., 2011).

The ADOG-C consists of 11 questions that present two options: one immediate choice that would allow for instant reinforcement but decreased probability of academic success and a delayed choice that would increase the probability of academic success. For instance, one question states "You have an assignment due tomorrow" and the two choices are A "Don't play with friends but study at home in order to finish the assignment" (the delayed gratification choice) or B "Play with friends first and then go back home to do the assignment" (the immediate gratification choice; Zhang et al., 2011). Students were instructed to fill out a 6-point Likert-scale for each question (1 = definitely choose A, 2 = probably choose A, 3 = rather choose A than B, 4 = rather choose B than A, 5 = probably choose B, 6 = definitely choose B). Choices were presented in a counterbalanced order across the questions, but are scored with lower Likert-values corresponding to lower academic delay of gratification. Item means (1 – 6) are used for analysis.

In order to validate the student's ADOG-C scores, a delay of gratification questionnaire for teachers was developed and administered in the current study (see Appendix D). Although Zhang et al. (2011) developed a teacher version of the ADOG questionnaire (the ADOG-T), it involved significant guesswork about the students' behavior outside of school. Instead, a novel teacher questionnaire was developed in the current study in order to probe student ADOG behaviors that were witnessed within the classroom.

Reinforcer. A 7.5 X 9.5 in. iPad was available throughout the session on the table next to the children. Various age-appropriate games were pre-downloaded as well as internet-access to age-appropriate websites was provided.

Procedure

Students were removed from class individually and brought to an empty classroom to work. All participants completed both the experimental and control worksheets in a counterbalanced order. The session began with the student having free access to the reinforcer for 2 minutes. The student then sampled the first selected worksheet by completing the first four problems. This allowed the student to contact one example of an easy interspersed problem when sampling the experimental worksheet. Students were instructed to work as quickly and accurately as possible.

Once the sample was complete, the experimenter told the student, “I would like you to work on this assignment for 10 minutes. I will tell you when the time is up. If you’re done beforehand you can play with the iPad. I will be over here working if you need anything.” The experimenter then started the timer for 10 minutes. In order to more closely simulate a homework scenario (which typically involves minimal supervision), the experimenter moved away from the student and worked on another activity, while still keeping the student in their peripheral vision. If the student engaged with the iPad at any point during the 10 minutes, the experimenter was to stop the timer and record how long the student worked on the worksheet. The student would then be allowed to play with the iPad for the remainder of the 10 minute interval plus the 5 minute reinforcement interval. Next, the student repeated the same process with the second worksheet. At the end of the experiment, the student filled out the preference questionnaire and ADOG-C, and then returned to class.

Analyses

Academic performance. To evaluate the students’ academic performance, the following dependent measures were assessed for each worksheet: problem accuracy, total problems completed, target problems completed, total digits correct, target digits correct, and time spent working on the assignment. Since McDonald and Ardoin (2007) found conflicting results when digits correct versus problems correct were used as the dependent variable, both measures were used as dependent variables in the current study. Within-subjects *t*-tests were used to assess significant differences between the two worksheets, with an alpha level of .05. A Bonferroni correction of .008 ($\alpha/6$) was used to protect against Type I error inflation.

Student preference. To determine student preference, students' perception of assignment difficulty, time, effort, and choice were assessed. Within-subjects *t*-tests were used to assess significant differences between the Likert-scale preference ratings of the two worksheets, with an alpha level of .05. A Bonferroni correction of .0125 ($\alpha/4$) was used to protect against Type 1 error inflation.

Delay of gratification. To measure students' academic delay of gratification (ADOG) ability, a mean ADOG-C score was calculated ranging from 1 (low delay of gratification) to 6 (high delay of gratification). A factor analysis was conducted on the teacher ADOG questionnaire to select the final questionnaire items. Mean teacher ADOG scores were calculated for each student and a correlation analysis was run to assess the relationship between the ADOG-C and teacher ADOG scores. An ANCOVA was used to test and control for the possible covariance between the ADOG-C scores and academic performance and student preference.

Procedural Integrity, Interobserver Agreement, and Interscorer Agreement

To ensure procedural integrity, the main experimenter filled out a procedural checklist for each participant (see Appendix E). In addition, a second experimenter accompanied the main experimenter for approximately 33% of the participants and completed a second procedural checklist for interobserver agreement. Procedural integrity was calculated by dividing the number of completed steps by the total number of checklist steps and multiplying by 100. Interobserver agreement was calculated by dividing the number of steps agreed upon by the total number steps and multiplying by 100. Procedural integrity and interobserver agreement were both 100%.

When calculating academic performance, an experimenter used an answer key to score the number of completed problems and problem accuracy. A second experimenter scored approximately 33% of the worksheets to assess scoring reliability. Interscorer agreement was calculated by dividing the number of problems agreed upon by the total completed problems and multiplying by 100. Interscorer agreement was 100% for the academic performance scores.

Results

Academic Performance

All 19 participants worked on each assignment for the entire 10-minute length and did not engage with the iPad until the time limit ended. Two students began skipping target problems and only worked on the easy problems during the experimental assignment, but their data was still included since rerunning the analyses without their data did not change the results. Descriptive statistics for academic performance on each assignment type are shown in Table 1.

Table 1
Academic Performance Results per Assignment

Performance Category	Mean (*SD*)		*t*-test			
	Control	Experimental	*df*	*t* - value	*p*	*r*
Total Problems Completed*	29.84 (11.81)	35.53 (10.99)	18	3.38	0.003	0.39
Target Problems Completed	29.84 (11.81)	26.74 (08.20)	18	1.81	0.087	0.15
Total Problems Correct*	24.00 (10.99)	30.32 (12.18)	18	4.55	0.000	0.53
Target Problem Accuracy (%)	79.83 (21.17)	80.26 (24.09)	18	0.13	0.898	0.00
Total Digits Correct*	62.68 (26.39)	79.95 (31.70)	18	4.15	0.001	0.49
Target Digits Correct	62.68 (26.39)	68.47 (28.25)	18	1.54	0.140	0.12

*Significant after Bonferroni correction of α/6 was applied

Analyses showed that students completed significantly more total problems (target problems plus interspersal problems) on the experimental (M = 35.53; SD = 10.99) assignment compared to the control assignment (M = 29.84; SD = 10.99) assignment ($t(18)$ = 3.38, p = .003, r = .39). Students also completed more total problems correctly on the experimental (M = 24.00; SD = 10.99) assignment compared to the control (M = 30.32, 12.18) assignment (t(18) = 4.55, p =.000, r = .53). In addition, total digits correct was also significantly greater on the experimental (M = 79.95; SD = 31.7) assignment versus the control (M = 62.68; SD = 26.39) assignment (t(18) = 4.15, p = .001, r = .49). Surprisingly, students completed more target problems on the control (M = 29.84; SD = 11.81) assignment compared to the experimental (*M* = 26.74; *SD* = 8.2) assignment, although this difference was not statistically significant ($t(18) = 1.81, p = .087, r = .15$). Analyses showed that there was no significant difference in the target digits correct between the experimental (*M* = 68.47; *SD* = 28.25) assignment and control (*M* = 62.68; *SD* = 26.39) assignment ($t(18) = 1.54, p = .14, r = .12$). No significant differences were found between target problem accuracy between the experimental (*M* = 80.26; *SD* = 24.09) and control (*M* = 79.83; *SD* = 21.17) assignments ($t(18) = .13, p = .90, r = .00$).

Assignment Preference

Descriptive statistics for the Likert-preference-ratings of each assignment type are shown in Table 2.

Table 2
Preference Rating Results per Assignment

Preference Category	Mean (*SD*)		*t* - tests			
	Control	Experimental	*df*	*t*-value	*p*	*r*
Like rating	3.79 (1.03)	4.16 (.76)	18	1.93	0.069	0.17
Difficulty rating	2.84 (1.01)	2.22 (1.19)	18	2.16	0.045	0.27
Effort rating	3.21 (1.13)	3.26 (.93)	18	0.22	0.826	0.00
Time rating	3.79 (0.71)	3.53 (1.07)	18	1.42	0.172	0.10

Note. No significant values found after Bonferroni correction of $\alpha/4$ was applied

Students liked the experimental assignment (*M* = 4.16; *SD* = .76) more than the control assignment (*M* = 3.79; *SD* = 1.03), although the difference was not significantly different ($t(18) = 1.93, p = .07, r = .17$). Analyses showed that students rated the experimental assignment as less difficult (*M* = 2.22; *SD* = 1.19) than the control assignment (*M* = 2.84; *SD* = 1.01) although the results were not significantly different after a Bonferroni correction was applied ($t(18) = 2.16, p = .045, r = .27$). There was not a significant difference found between how effortful the students rated the experimental (*M* = 3.26; *SD* = .93) and control (*M* = 3.21; *SD* = 1.13) assignments ($t(18) = .22, p = .83, r = .00$). Analyses also showed that there was not a significant difference between how time-intensive the students rated the experimental (*M* = 3.53; *SD* = 1.07) and control (*M* = 3.79; *SD* = .71) assignments ($t(18) = 1.42$, $p = .17$, $r = .10$).

Academic Delay of Gratification

Teacher questionnaire development. A principal components analysis (PCA) was conducted on the 14 items from the teacher ADOG questionnaire with oblique rotation (direct oblimin). An oblique rotation was chosen given that any underlying factors should be related to one another since they all assess academic delay of gratification (ADOG). The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = .629, and all KMO values for individual question items were above .5, except for questions 3 and 6. Bartlett's test of sphericity χ^2 (91) = 275.83, $p < .001$, indicated that the correlation between items was sufficiently large for PCA. An initial analysis was run to obtain eigenvalues for each component in the data. Three components had eigenvalues over Kaiser's criterion of 1 and in combination explained 79.19% of the variance: component 1 explained 63.11% of the variance, component 2 explained another 9.65%, and component 3 explained 8.37%. The scree plot was slightly ambiguous and showed inflexions that would justify retaining either one or three factors. Given that the purpose of the questionnaire was to only measure one factor (ADOG) and given that the original teacher questionnaire developed by Zhang et al. (2011) had only one factor (ADOG), one factor was retained in the current analysis. Based on the structure matrix factor loadings, two items (questions 3 and 6) were deleted from the final version of the questionnaire since their factor loadings were less than .50. Table 3 shows the 12 final questions that were retained and their factor loadings to the single ADOG factor.

Table 3.
Teacher ADOG questions and Factor Loadings

Questionnaire Item	Loading
1. Your students have an assignment due at the end of the class period. Which is your student most likely to do? A. Work on it consistently throughout the class period. B. Mess around in class and then rush to finish it last minute before turning it in.	.67
2. You are teaching a lesson during class. Which is your student most likely to do? A. Pay attention in class and take notes. B. Talk with friends or play around rather than paying attention	.82
4. Your students have a test at the end of the week. Which is your student more likely to do? A. Wait until the end of the week to start studying. B. Start studying ahead of time in order to do well.	.90
5. You have to step out of the room for a minute and tell your students to keep working. Which is your student more likely to do? A. Keep working on his / her assignment. B. Immediately start talking with friends.	.75
7. Your student does not understand a class assignment. Which is your student more likely to do? A. Come talk with you about the assignment after class and then leave. B. Leave class even though he / she doesn't understand it	82
8. Your students have a test tomorrow and are given an opportunity to study for it in class. Which is your student more likely to do? A. Study for the test. B. Play around rather than studying for the test.	.85
9. You give your students a variety of assignments in class. Which is your student more likely to do? A. Do all of the assignments regardless of whether he/she likes them or not. B. Only do the assignments that he / she enjoys and then skip the rest of them.	.79
10. Students are given an assignment in class and told to work silently at their desk. Which one do you think your student will do? A. Get up and move around the classroom a lot or engage in other off-task behaviors. B. Sit at the desk and work on the assignment.	.62

Table 3 continued

Questionnaire Item	Loading
11. In regards to the content of your class, which is your student more likely to do? A. He / she is happy and participates regardless of what the subject is. B. He / she is only happy and participates if it is a subject that he / she likes.	.82
12. You tell your students that they can quietly talk among themselves once they complete their assignment. Which is your student more likely to do? A. Finish the assignment first and then talk with his / her friends. B. Start talking with peers first and complete the assignment later.	.63
13. Your student has a test tomorrow. Which is your student more likely to do? A. Talk with friends during class even though it might mean getting a bad grade on the test. B. Don't talk with friends and pay attention in class in order to get a good score on the test.	.80
14. Your student is working on a difficult and long assignment and is becoming increasingly frustrated with it. Which is your student more likely to do? A. Give up since it is taking too long and talk with a friend instead. B. Keep working on it even though it is taking a while.	.90
Eigenvalue	8.84
Explained variance	63.11
Chronbach's α for the revised questionnaire (12 questions)	0.96
Chronbach's α for the original questionnaire (l4 questions)	0.92

Child and teacher questionnaire scores. Based on self-report, students had an average ADOG-C scale score of 5.48 (*SD* = .44; Range = 4.64 – 6.00), indicating high delay of gratification. Using the teacher rating scores from the adjusted teacher questionnaire based on the factor analysis, teachers rated that students had an average ADOG scale score of 4.25 (SD = .82, Range = 3.08 – 5.83), which also indicates that students had high delay of gratification. Nonetheless, a correlational analysis revealed that there was not a significant correlation between teacher and student ADOG ratings, $r = .10$, $p = .67$.

Using ADOG as a covariate. Correlations were run between the change in academic performance and student preference scores and the covariate, the ADOG-C scale score. The only variable that was found to have a significant correlation with the ADOG-C score was the student's perception of assignment time-intensity, $r = .498$, $p < .05$. The results of the repeated-measures ANCOVA showed that after controlling for the covariate, ADOG-C scores, assignment type had a significant impact on student's rating of how time-intensive the assignment was, $F(1,17) = 6.19$, $p < .05$, partial $\eta^2 = .02$.

Discussion

The purpose of the current study was to replicate and extend research on the discrete task completion hypothesis and interspersal technique by examining their applicability to homework situations. Students were exposed to two assignments: a control assignment, which contained only target problems, and an interspersal assignment, which contained easy problems interspersed after every third target problem. In order to simulate a homework situation, students were given limited supervision and had access to a nearby iPad during assignment completion. If the discrete task completion hypothesis holds true that students are reinforced by task completion, students should spend longer working on the experimental than control assignment before switching over to engage with the reinforcer. Despite this prediction, none of the participants engaged with the iPad during either assignment. These students displayed rule-governed behavior, which is when behavior is controlled by instructions rather than direct contingencies (Skinner, 1966). Because students have an extensive learning history of being reinforced for following adults' rules, particularly "first work, then play," it is understandable that they would choose to do work, even while having free access to a nearby reinforcer. Nonetheless, since students did not engage with the iPad during the assignments, the current study was not able to analyze the difference in on-task behavior across the two assignment types. Possible future studies that could better examine this difference will be discussed subsequently.

In regards to academic performance, students completed more total problems, more total problems correctly, and more total digits correctly on the experimental compared to the control assignment, which is in line with previous research. These results demonstrate that the researcher was successful in increasing total problem rates by interspersing additional easy problems on the experimental assignment. When asked about preference, students rated that they liked the experimental assignment more and thought it was easier than the control assignment. Furthermore, when controlling for student's ability to delay academic gratification, students rated the experimental assignment as less time-intensive than the control assignment. These preference findings are in accordance with previous studies, which have found that students favor interspersal over control assignments (Billington & Cruchon, 2004; Billington, Skinner, Hutchins, & Malone, 2004; Cates & Erkfritz, 2007; Hawkins et al., 2005; Logan & Skinner, 1998; McDonald & Ardoin, 2007; Robinson & Skinner, 2002; Skinner et al, 1996; Skinner, Robinson, et al., 1996). The only preference rating that did not change between the two assignments in the current study, but did in previous studies, was students' perception of task effort. However, previous studies differed in that they used a dichotomous method of measurement ("Which assignment is more effortful?") to demonstrate that interspersal assignments are perceived as less effortful (Billington & Skinner, 2002; Billington, Skinner, Hutchins, & Malone; 2004; Cates & Erkfritz, 2007; Logan & Skinner, 1998; McDonald & Ardoin, 2007), whereas the current study used a 5-point Likert scale to assess preference. Overall, the preference results of the current study are in line with previous interspersal research that students prefer interspersal to control assignments.

In examining the actual strength of the preference differences, the current study found that the difference is not practically significant. When asked how much they liked the assignment, the students' mean Likert-ratings were 3.79 for the control assignment, which falls closer to 4 ("like slightly") than 3 ("neutral"), and 4.16 for the experimental assignment, which falls closer to 4 ("like slightly") than 5 ("like strongly"). Since students were only allowed to use whole numbers, rounding the mean ratings for both assignments to the nearest whole interval produced the same rating: "like slightly" (4). Thus, although there was a difference in student preference between the two assignments, this difference was not practically meaningful. Furthermore, this preference was difference was not related to student behavior since students worked on both assignments for the entire time interval rather than work longer on the assignment that they liked more. When asked how much time each assignment would take to complete from start to finish, mean student ratings rounded to 4 ("a lot") for both the interspersal (M = 3.53) and control (M = 3.79) assignment, again demonstrating a non-meaningful difference. The only preference item that rounded to different ratings was difficulty: students' mean rating for the control assignment (M = 2.84) rounded to 3 ("neutral") and their mean rating for the interpersal assignment (M = 2.26) rounded to 2 ("slightly easy"), indicating that students found the interspersal assignment to be less difficult. However there was a large amount of variability in all four preference-ratings (most varied by $\pm$ 1 Likert points), so this difference in perceived difficulty could simply be due to variability. As was the case with students' preference ratings, their difficulty ratings were not related to their behavior because they worked for the same amount of time on both assignments, regardless of difficulty.

In addition, the current study had an important contradictory finding that should be noted. Students completed more target problems on the control compared to experimental assignment, although these results only approached significance. This finding counters previous interspersal research, which has found that students complete equal amounts of target problems on both assignments (e.g., Cates & Erkfritz, 2007) or complete more target problems on the experimental assignment (e.g., Billington et al., 2004). This finding is, however, similar to McDonald and Ardoin (2007), who found that students completed a greater number of target digits correctly on the control worksheet. Given the small sample size and the large variability in the current study, it is unclear whether these results are practically significant or not. Nonetheless, it does suggest caution when interpreting the efficacy of the interspersal procedure and its support for the discrete task completion hypothesis. Students may have preferred the experimental assignment because they completed less target problems on this assignment, rather than due to problem completion being reinforcing. More importantly, these results counter the purpose of using the interspersal procedure (i.e., to increase reinforcement without sacrificing practice opportunities), since students did not complete as many target problems on the experimental assignment and thus did not receive the same opportunity to practice the targeted academic skill.

Nevertheless, the fact that the students completed more target problems on the experimental assignment does make logical sense given the time parameters. When working on the experimental assignment, students had to split their time between interspersal and target problems and therefore had less overall time to devote to target problems. In contrast, when working on the control assignment, students had the entire time to work on target problems, so it makes sense that they would complete more target problems on this assignment. Perhaps previous studies did not encounter this issue since participants were older (the original samples were college-aged). Those participants were able to complete the 1 X 1-digit problems quickly so they still had ample time to complete high amounts of target problems. Because the participants in the current study were younger, they required more time to complete the 1+1-digit problems, and thus had less time to complete the target problems. This in turn suggests that the interspersal procedure only avoids sacrificing practice opportunities if students are able to complete interspersal problems at an extremely high rate, which is not the case for most students.

Limitations and Future Directions

Future research should be conducted to address the limitations of the current study. The main limitation of the study was the small sample size. Although the sample size fell within the desired range produced by a G*Power Analysis, a larger sample size would have added additional power to the study. A larger sample would particularly be useful in decreasing the variance in academic performance and preference ratings. This, then, would increase the precision of the results and therefore aid in assessing the effect of the interspersal assignment on academic performance and student preference. Future research should therefore be conducted using a larger sample of students. Furthermore, future research should also be conducted on multiple grade levels to examine if the results of the present study replicate across grade levels. It would be particularly of use to examine target completion rates among different age levels to test whether older students are able to complete the interspersal problems at fast enough rates to avoid sacrificing practice opportunities. Therefore research also needs to be conducted using a variety of interspersal problem types (i.e., beyond just 1 + 1 problems) in order to assess whether the procedure is effective across a range of problem types.

Another limitation of the current study was that students engaged in rule-governed behavior with the experimenter. The researchers had hoped to examine the differences in task performance and student preference in the context of a competing reinforcer, but as students did not engage with the iPad during assignment completion, this analysis was not possible.

Future research should be conducted with parents at home since students might have a different learning history for task completion and rule-following at home versus at school. Additionally, future research should also be conducted on students' transition from rule-governed to contingency-shaped behavior. In their review on reinforcement schedule research, Lattal & Neef (1996) discuss how individuals display rule-governed behavior at first, but as the rules less-accurately predict reinforcement, individuals will display more contingency-based behavior, instead. It would therefore be interesting to examine at what point students switch from engaging in rule-based behavior (e.g., following the rule "first work, then play") to engaging in contingency-shaped behavior (e.g., engaging with the iPad for immediate reinforcement).

A third limitation of the present study was the lack of convergent validity between the student and teacher academic delay of gratification (ADOG) scores. In the current study, the correlation between these scores was low and not significant (r = .10). This differed from Zhang et al. (2011), who found that there was a moderate and significant correlation between the ADOG-C and ADOG-T scores (r = .41). Since the teacher questionnaire developed by Zhang et al. (2011) required teachers to guess about their students' behavior outside the classroom, the teacher questionnaire in the current study was developed to only target students' behavior within the classroom. Therefore one reason for the lack of convergent validity could be that students were assessing their ADOG skills both in and out of the classroom whereas teachers were only evaluating the students' ADOG skills within the classroom. Future studies should be conducted to determine whether students' ADOG ability differs depending on the context (e.g., in the classroom versus at home) in order to better understand how to promote students' on-task behavior across contexts. Furthermore, the teacher-rating sale was developed using a small n for factor analysis based on a single informant, so the data from these ratings are exploratory at best. Future research should also be conducted to develop a teacher questionnaire for student ADOG using a larger sample size and multiple teacher informants.

Conclusion

Overall, the results of the current study caution the use of the interspersal procedure for academic assignments. Although students did prefer the interspersal assignment and rate it as less difficult and time-intensive, the magnitude of the difference was small and not practically meaningful. Furthermore, students completed more target problems on the control rather than the interspersal assignment, which violates the purpose of using the interspersal procedure (i.e., to increase reinforcement without decreasing practice opportunities for the target problems). Decreased target problems are particularly problematic in the context of homework assignments, since homework is used to provide additional practice opportunities in order to increase skill proficiency and generalization. Thus, the results of the present study raise concern about using the interspersal procedure for homework assignments given that the experimental assignment did not enhance student engagement and decreased target problem completion. Additional research with homework assignments across a wider array of students and using a variety of interspersal problem types is therefore needed in order to determine the efficacy of using the interspersal procedure during academic assignments.

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Appendix A
IRB Approval

ACTION ON EXEMPTION APPROVAL REQUEST

Institutional Review Board
Dr. Dennis Landin, Chair
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TO: Catherine Lark
Psychology

FROM: Dennis Landin
Chair, Institutional Review Board

DATE: September 24, 2014

RE: **IRB#** E8945

TITLE: Evaluating the Interspersal Procedure Using Free Access to a Competing Reinforcer

New Protocol/Modification/Continuation: New Protocol

Review Date: 9/23/2014

Approved ___X___ **Disapproved** ________

Approval Date: 9/23/2014 **Approval Expiration Date:** 9/22/2017

Exemption Category/Paragraph: 1

Signed Consent Waived?: No

Re-review frequency: (three years unless otherwise stated)

LSU Proposal Number (if applicable): ________

Protocol Matches Scope of Work in Grant proposal: (if applicable) ________

By: Dennis Landin, Chairman ________________

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING –
Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. SPECIAL NOTE:

**All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb*

Appendix B
Preference Sheets

Please answer each question about Assignment A based on a 1 – 5 scale

1. How much did you like this assignment?

1----------------2---------------3----------------4---------------5

1	2	3	4	5
Dislike strongly	Dislike slightly	Neutral	Like slightly	Like strongly

2. How difficult was this assignment?

1----------------2---------------3----------------4---------------5

1	2	3	4	5
Very Difficult	Slightly Difficult	Neutral	Slightly Easy	Very Easy

3. How much effort would this assignment require to complete from start to finish?

1----------------2---------------3----------------4---------------5

1	2	3	4	5
Very little	A little	Medium	A lot	Very much

4. How much time would this assignment require to complete from start to finish?

1----------------2---------------3----------------4---------------5

1	2	3	4	5
Very little	A little	Medium	A lot	Very much

Please answer each question about Assignment B based on a 1 – 5 scale

1. How much did you like this assignment?

1----------------2---------------3----------------4---------------5

Dislike strongly	Dislike slightly	Neutral	Like slightly	Like strongly

2. How difficult was this assignment?**

1----------------2---------------3----------------4---------------5

Very Difficult	Slightly Difficult	Neutral	Slightly Easy	Very Easy

**note: this item was reverse scored

3. How much effort would this assignment require to complete from start to finish?

1----------------2---------------3----------------4---------------5

Very little	A little	Medium	A lot	Very much

4. How much time would this assignment require to complete from start to finish?

1----------------2---------------3----------------4---------------5

Very little	A little	Medium	A lot	Very much

Appendix C
Academic Delay of Gratification Scale for Children (ADOG-C)

1. You have a test tomorrow
    - A. Play with friends even though it may mean getting a bad score on the test.
    - B. Don't play with friends but study at home in order to get a good score on the test.

2. You have a test tomorrow
    - A. Watch your favorite TV program even though it may mean getting a bad score on the test.
    - B. Don't watch your favorite TV program but study at home in order to get a good score on the test.

3. You have an assignment due tomorrow
    - A. Don't play with friends but study at home in order to finish the assignment.
    - B. Play with friends first and then go back home to do the assignment.

4. About the content of the test
    - A. Spend most of your time studying the subjects that you like.
    - B. Study every subject well-balanced regardless of whether you like it or not.

5. You have a test tomorrow
    - A. Watch your favorite sports game even though it may mean getting a bad score on the test.
    - B. Don't watch your favorite sports game but study at home in order to get a good score on the test.

6. On class days
    - A. If there are some classes you like, you will go to school very happy; If there are some classes you don't like, you will be unwilling to go to school.
    - B. Go to school happily no matter what classes you have.

7. When you don't understand the content of a class
    - A. Go back home soon after class even though you don't understand what you learned in the class.
    - B. Ask the teacher what you don't understand soon after the class.

8. About the study time
    - A. If your teacher is in the classroom, you will study; If the teacher leaves the classroom, you will talk or play with your classmates immediately.
    - B. Study seriously no matter whether the teacher is in the classroom or not.

9. You have an assignment due tomorrow
    A. Finish the assignment first, then do something you like (for example, watch your favorite TV program).
    B. Do something you like first (for example, watch your favorite TV program), and then do the assignment.

10. You have a test in the near future
    A. Cut down the time spent watching TV and study a little bit every day in order to prepare for the test.
    B. Spend most of your time watching TV and only study hard just before the test.

11. About your attitude during the class
    A. Do something you like (for example, drawing pictures) without listening to the teacher during the class, and copy your friend's notes later.
    B. Listen to the teacher carefully during the class and do something you like (for example, drawing pictures) during break time.

Appendix D
Teacher Academic Delay of Gratification Questionnaire

Student __________________

1. Your students have an assignment due at the end of the class period. Which is your student more likely to do?
    A. Work on it consistently throughout the class period.
    B. Mess around in class and then rush to finish it last minute before turning it in.

2. You are teaching a lesson during class. Which is your student more likely to do?
    A. Pay attention in class and take notes.
    B. Talk with friends or play around rather than paying attention.

3. Your student does not understand how to an assignment. Which is your student more likely to do?
    A. Give up on the assignment and receive a bad score on it.
    B. Continue trying to figure it out and / or ask you for help.

4. Your students have a test at the end of the week. Which is your student more likely to do?
    A. Wait until the end of the week to start studying.
    B. Start studying ahead of time in order to do well.

5. You have to step out of the room for a minute and tell your students to keep working. Which is your student more likely to do?
    A. Keep working on his / her assignment.
    B. Immediately start talking with friends.

6. Your students are given an assignment to do in class and are told that they can pick a game to play once they are done. Which is your student more likely to do?
    A. Go play with the games and finish the assignment later.
    B. Finish the assignment and then go play with the games.

7. Your student does not understand a class assignment. Which is your student more likely to do?
    A. Come talk with you about the assignment after class and then leave.
    B. Leave class even though he / she doesn't understand it.

8. Your students have a test tomorrow and are given an opportunity to study for it in class. Which is your student more likely to do?
    A. Study for the test.
    B. Play around rather than studying for the test.

9. You give your students a variety of assignments in class. Which is your student more likely to do?
    A. Do all of the assignments regardless of whether he/she likes them or not.
    B. Only do the assignments that he / she enjoys and then skip the rest of them.

10. Students are given an assignment in class and told to work silently at their desk. Which one do you think your student will do?
    A. Get up and move around the classroom a lot or engage in other off-task behaviors.
    B. Sit at the desk and work on the assignment.

11. In regards to the content of your class, which is your student more likely to do?
    A. He / she is happy and participates regardless of what the subject is.
    B. He / she is only happy and participates if it is a subject that he / she likes.

12. You tell your students that they can quietly talk among themselves once they complete their assignment. Which is your student more likely to do?
    A. Finish the assignment first and then talk with his / her friends.
    B. Start talking with peers first and complete the assignment later.

13. Your student has a test tomorrow. Which is your student more likely to do?
    A. Talk with friends during class even though it might mean getting a bad grade on the test.
    B. Don't talk with friends and pay attention in class in order to get a good score on the test.

14. Your student is working on a difficult and long assignment and is becoming increasingly frustrated with it. Which is your student more likely to do?
    A. Give up since it is taking too long and talk with a friend instead.
    B. Keep working on it even though it is taking a while.

Appendix E
Thesis Checklist

Participant # ______________________ IOA? (Y/N) _________________

Experimenter _____________________ Date _________________________

1. __________ Experimenter obtained written assent.
2. __________ Experimenter consulted session order.
3. __________ Student had free access to iPad for 2 minutes.
4. __________ Student sampled first 4 problems on 1st assignment.
5. __________ Experimenter recorded time for 1st 10-minute-work/play-interval.
6. __________ Student filled out preference questionnaire for 1st assignment
7. __________ Student had 5 minutes on iPad.
8. __________ Student sampled first 4 problems on 2nd assignment .
9. __________ Experimenter recorded time for 2nd 10-minute-work/play-interval.
10. __________ Student filled out preference questionnaire for 2nd assignment
11. __________ Student had 5 minutes to play on iPad
12. __________ Student filled out ADOG-C questionnaire.

Time spent on 1st assignment ____________________

Time spent on 2nd assignment ____________________

Vita

Catherine Rose Lark, a native of Dallas, Texas, received her bachelor's degree in psychology with a minor in Spanish at Austin College in 2013. During college, she worked as a behavioral therapist at two applied behavior analysis (ABA) clinics for children with Autism. She also conducted an honors thesis on the use of functional analysis to reduce tantrum behavior for a child with Autism. These experiences contributed to her interest in the use of ABA to decrease problem behavior in children with disabilities. Based on this interest, she decided to enter graduate school in the Department of Psychology at Louisiana State University. She will receive her master's degree in August 2015 and continue working towards her doctorate in School Psychology.